NORTHROP GRUMMAN

DEFINING THE FUTURE™

Web-Based Interoperable Sensor Network

PULSENet™

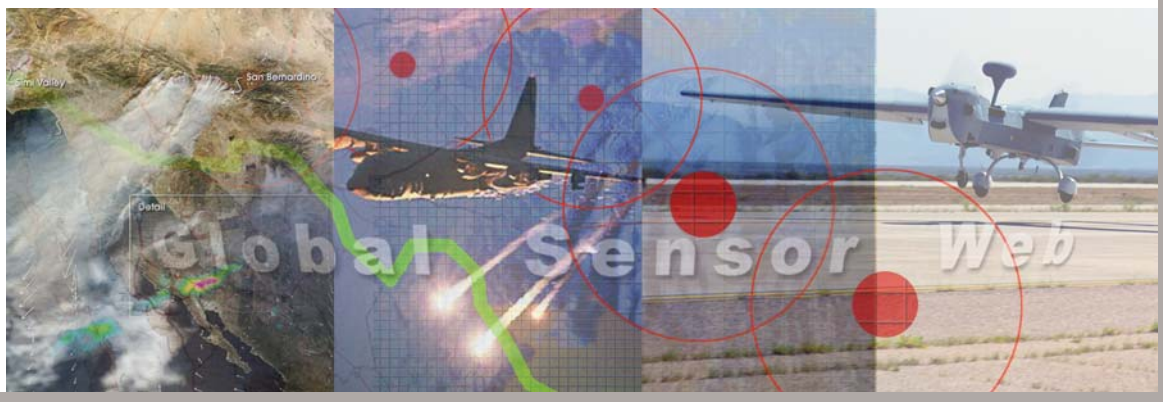
The Challenge

Today's sensor networks are stove-piped; they lack interoperability. This lack of interoperability has evolved out of an increasing departure from accepted integration standards fueled by the need for new and advanced sensor technologies. The sophistication of sensor systems now generates data that no longer conforms to existing message formats, communications, and target information. Integrating new sensors into existing communications architectures has become increasingly difficult, often requiring extensive custom software development and specialized hardware configuration, which adds to the cost and complexity of sensor operations. Furthermore, current sensor networks are typically controlled by different organizations with different operational requirements. There is no standard way of sharing sensor data across organizations, which makes it difficult or impossible for an individual outside of a controlling organization to discover and utilize sensors that meet his or her needs.

Sensor data has even higher value when it can be fused with data from multiple sources. High-value sensor data often goes unexploited due to the failure of traditional information management systems to discover, manage, and relate this data. This failure, caused in part by the technological and organizational stovepipes that exist in today's sensor networks, results in a gap between data and users' ability to transform data into actionable knowledge.

Given that sensor networks are composed of spatially distributed autonomous sensors, it is critical that they can cooperatively monitor the environment. The sensors need to communicate with one another, usually wirelessly, and have the ability to coordinate their measurements based on activity in other parts of the network.

The challenges inherent in today's sensor networks expound the need for an interoperable, global sensor network, or Global Sensor Web. Sensor webs connect spatially distributed autonomous sensor networks to the web through standard interfaces and expose sensor measurements and observations, such as temperature or pollutant concentrations, to decision support systems, environmental models, and other users.



Enabling a Global Sensor Web

Northrop Grumman offers Persistent Universal Layered Sensor Exploitation Network (PULSENet™), a comprehensive solution designed to address the need for an interoperable, global sensor network. PULSENet™ provides access to and control of disparate sensors through an architecture founded on Service-Oriented Architecture (SOA) and the Open Geospatial Consortium (OGC®) Sensor Web Enablement (SWE) suite of web services and encodings. The PULSENet™ architecture enables interoperability between:

- Heterogeneous sensors (from simple, stationary Unattended Ground Sensors [UGS] to complex imaging sensors mounted on mobile platforms like UAVs and satellites)
- Disparate and complex sensor networks
- Sensor models
- Decision support tools

Within the PULSENet™ architecture, sensors and their data are described in common, XML-based formats: Sensor Model Language (SensorML) for sensor descriptions, Observations and Measurements (O & M) for sensor data, and Transducer Markup Language (TML) for streaming sensor data. In addition to standard formats for data, the PULSENet™ architecture provides standard, SWE-based web services that allow a user to:

- Quickly discover sensors (secure or public) within an area of interest based on his or her needs (observables, ability to task, quality, etc.)
- Obtain sensor descriptions in a common format that is understandable by a user and his or her software
- Readily access sensor observations in a common manner and in a form specific to his or her needs (current or historical)
- Task sensors, when possible, to meet his or her needs
- Subscribe to and receive sensor alerts that meet his or her criteria

PULSENet™ combines the OGC® SWE standard web services and formats for sensor data with existing OGC® web services for map and feature data to provide end users with enhanced data fusion, visualization, and exploitation capabilities.

By standardizing formats for sensor data and the processes of sensor discovery, access, tasking, and alert subscription and notification, PULSENet™ breaks the stovepipes in today's sensor networks and bridges the distance between heterogeneous sensor networks, models, and decision support tools. The outcome is extensive sensor applications that are globally-scalable, vendor-neutral, and adaptable to user needs.

PULSENet in Action

Northrop Grumman is currently working on two-way information exchange between sensors and earth science models. The project is making it easier to use sensor data as model inputs or to validate earth science model results and, conversely, to use model output to direct where, when and what sensors measure. Specifically, Northrop Grumman is testing interoperability within wildfire smoke analysis and forecasting applications. The locations of fires and smoke patterns detected by satellites and Unmanned Aerial Systems (UAS) are being served through standard interfaces and automatically pulled into analysis web services for comparison and validation with surface observations and smoke forecasts. Next steps include a more comprehensive system of connected and interacting sensors, models, and analysis services, including the use of forecasts in planning fire related measurements by satellites and UAS sensors.

To learn more about PULSENet, please send inquiries to Intel-Info@ngc.com or call 703.818.7400.

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